TETRA TECH

January 22, 2018

Erich Weissbart, P.G.
EPA Region 3, Land and Chemicals Division
701 Mapes Road
Fort Meade, MD 20755

RE: Statistical Analyses of Groundwater Monitoring Results for Underground Storage Tank (UST) No. 9 RCRA Corrective Action Permit MDD046279311 Former Appliance Park East Facility, Columbia, MD

Dear Mr. Weissbart:

On behalf of the General Electric Company (GE), this letter presents the results of the statistical evaluation of the groundwater monitoring data conducted for the former UST No. 9 site at the above-referenced facility per your email dated December 19, 2016. The statistical evaluation was conducted to support our request for EPA approval to proceed with final verification sampling to demonstrate attainment of groundwater clean-up goals.

The statistical evaluation is detailed in the enclosed Tetra Tech memorandum dated January 9, 2018. Both intra-well and inter-well statistical analyses indicate that although plume concentrations have fluctuated slightly above Maximum Contaminant Levels (MCLs) since 2008, chemicals of concern likely decreased to levels below MCLs by 2013.

Based on the statistical analyses and sampling results from the two most recent consecutive monitoring events (2014 and 2016) which show attainment of groundwater clean-up goals, we request EPA approval to proceed with the final verification sampling event in accordance with the 2013 Post-Termination Sampling and Analysis Plan (SAP).

Upon receipt of EPA approval, we will conduct the final verification sampling event in April/May 2017 to address potential seasonal variability in groundwater conditions. If the results of the final verification sampling confirm attainment of the clean-up goals, post-termination monitoring will be considered complete, and no further action required for UST No. 9. Otherwise, monitoring will continue as scheduled.

Please contact me at 410-990-4607 or belssi.chang@tetratech.com if you require additional information or have any questions.

Sincerely,

Belssi Chang Lee
Project Manager

Enclosure

Cc: K. Mooney, GE

TETRA TECH
51 Franklin Street, Suite 400, Annapolis, MD 21401
Tel 410.990.4607 Fax 410-990-4749 www.tetratech.com

TETRA TECH

TECHNICAL MEMORANDUM

Date: January 9, 2018

To: Belssi Chang

From: Dan Burnell, Ph.D.

Subject: Results of Data Analyses and Recommendation of Final Verification Sampling to Confirm Achievement of Maximum Concentration Level (MCL) Clean-up Standards, UST No. 9, Former Appliance Park East, Columbia, MD

The groundwater data from monitoring wells for the former UST No. 9 area at the former General Electric Appliance Park East in Columbia, MD (site) were analyzed to evaluate whether concentrations of chemicals of concern (COCs) (benzene, toluene, ethylbenzene, xylenes, and methyl tert-butyl ether [MTBE]) are below the federal Maximum Contaminant Levels (MCLs) based on data collected at the site from 1996 to 2016. In accordance with 40 CFR Subpart F 264.97 of the Resource Conservation and Recovery Act (RCRA) (RCRA), statistical analyses were also performed as part of this analysis. A summary of the data analyses and recommendations are provided below.

Data Analyses

Time Series Plots

Groundwater sampling has been performed from 1996 to 2016 to characterize and examine COC plume concentrations over time at the site. Potentiometric surface maps show that groundwater flow is to the southeast (Tetra Tech, 2016). Historical groundwater sampling data indicated that COC plumes were present in groundwater downgradient of the former UST No. 9. The limited extent of the plumes indicates that the COC plume velocities were low as a result of the low subsurface hydraulic conductivity, plume retardation from adsorption, and natural biodegradation causing COC mass destruction. Following removal of the UST No. 9 source, time series plots of COC groundwater monitoring data from 1996 to 2016 (**Attachment A**) show that COC concentrations in all monitoring wells have decreased significantly from 1996 to 2016. By 2008, groundwater concentrations were below MCLs in all monitoring wells except for a detection of benzene of 5.9 µg/L in monitoring well ERM-6. Although COC plume concentrations have fluctuated slightly above MCLs since 2008, all measured COC concentrations have been below MCLs since 2014. The observed decrease in COC plume concentrations over time is likely caused by natural attenuation processes including recharge dilution, hydrodynamic dispersion, and biodegradation of COCs.

Statistical Trend Analyses

In accordance with United States Environmental Protection Agency (USEPA) guidance documents (1994; 2006; 2009; 2015), statistical analyses were performed to analyze the groundwater plume concentration data to examine the downward trend in COC concentrations in downgradient monitoring well locations at the site. An intra-well examination of the COC data and individual well time series plots indicates that concentrations have decreased significantly and have been below MCLs since 2014 for all COCs. Given that the benzene plume concentrations have persisted longer above MCLs than other COCs plumes, exponential trend regression analyses were performed for benzene in each monitoring well. For conservativeness, non-detect measurements were not used in the regression analysis when later measurements still indicated a detection above MCLs. Although benzene concentrations have fluctuated and were occasionally above its MCL (5 µg/L), the regression lines

(**Attachment B**) showed a decreasing trend with benzene regression lines decreasing to below its MCL for all monitoring wells by 2013.

Hypothesis Testing

A closer examination of the regression analyses indicates that benzene concentrations in groundwater were below its MCL by 2008 in all the wells except ERM-6 with a detection of 5.9 µg/L. Hypothesis testing was therefore performed using ProUCL version 5.1 (USEPA, 2015) to examine whether average benzene plume concentrations from all monitoring wells have remained below its MCL since 2008. Given that the monitoring well network is sufficient to characterize the benzene plume, benzene concentrations in all monitoring wells with detections of benzene since 2008 were compiled to estimate average (median) benzene plume concentrations from 2008 to 2016. Given the presence of non-detects, a nonparametric sign test was used as recommended in USEPA ProUCL Version 5.1 Technical Guide (2015). At a 95% level of significance, the null hypothesis that median benzene concentrations were above MCLs was rejected. This inter-well analysis of data from monitoring wells located throughout the historical benzene plume, which is in agreement with results of the individual intra-well regression plots, indicates that average (median) benzene plume concentrations at the site were below MCLs from 2008 to 2016.

Summary and Recommendations

An examination of the COC groundwater data at the site indicates that COC plume concentrations have decreased significantly and are below MCLs as a result of both UST removal and natural attenuation processes at the site. The natural attenuation mechanisms likely include recharge dilution, hydrodynamic dispersion, and natural biodegradation. Although COC plume concentrations have fluctuated slightly above MCLs since 2008, both intra-well statistical analyses of data from both individual wells and inter-well analyses of data in the monitoring well network group indicate that average COC plume concentration levels have likely decreased to levels below MCLs by 2008. The groundwater sampling results from the last two monitoring events (2014 and 2016) show attainment of the groundwater clean-up goals for COCs in all monitoring wells at the site. Based on these analyses, it is recommended that a final verification sampling event be requested and performed to confirm the attainment of groundwater clean-up goals at this site.

References

Tetra Tech, 2016. Biennial Groundwater Sampling and Analyses for Underground Storage Tank (UST) No. 9 RCRA Corrective Action Permit MDD046279311 Former Appliance Park East Facility, Columbia, MD. November 30.

U.S. Environmental Protection Agency (EPA). 1994. Statistical Methods for Evaluating the Attainment of Cleanup Standards, EPA 230-R-94-004, Washington, DC.

U.S. Environmental Protection Agency (EPA). 2006. Data Quality Assessment: Statistical Methods for Practitioners, EPA QA/G-9S. EPA/240/B-06/003. Office of Environmental Information, Washington, DC.

U.S. Environmental Protection Agency (EPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530-R-09-007, 2009.

U.S. Environmental Protection Agency (EPA). 2015. ProUCL Version 5.1 Technical Guide. EPA 600-R-07-041, October 2015.

Attachments

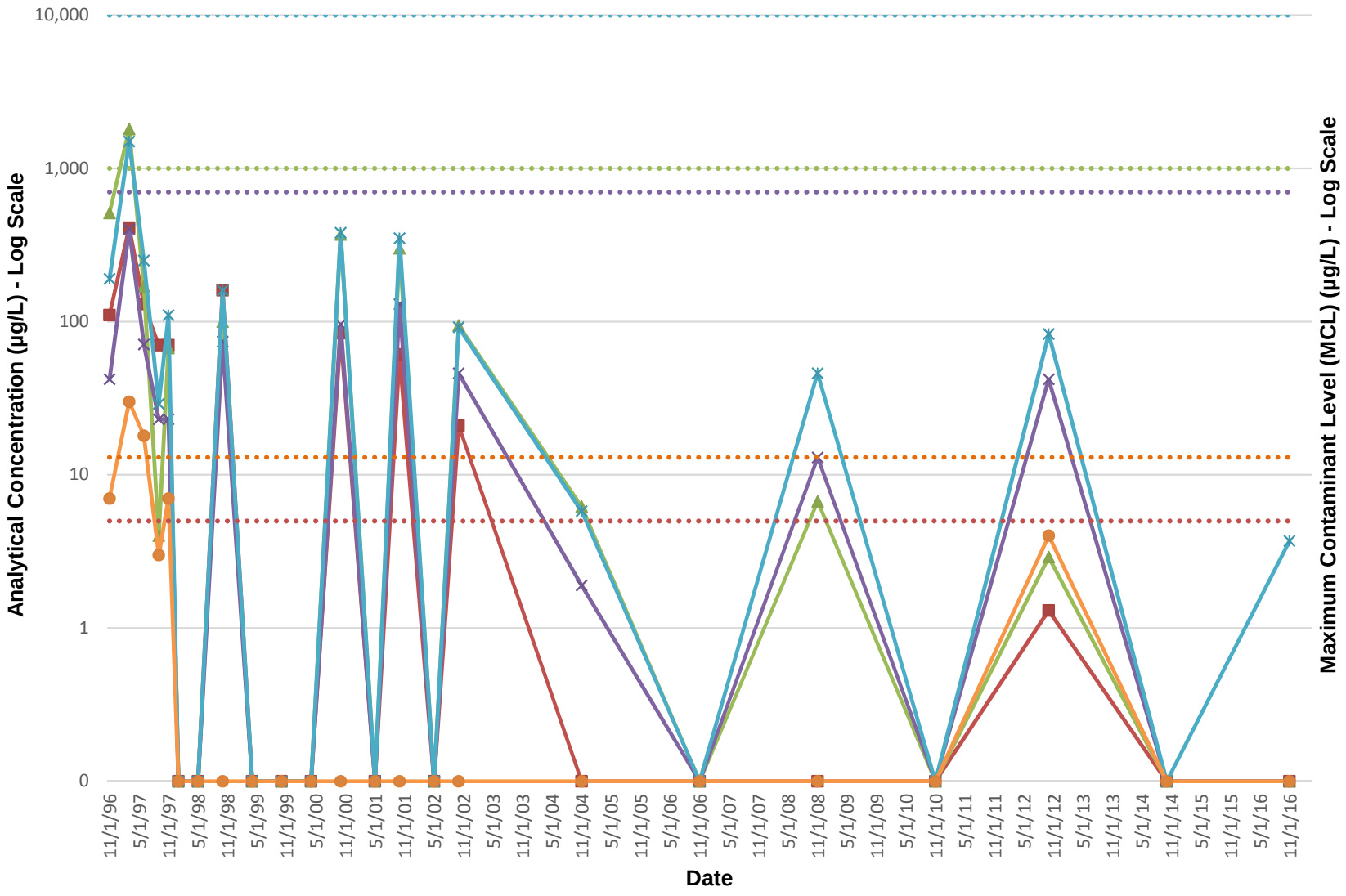
A. Time Series Plots
B. Benzene Regression Analysis Plots

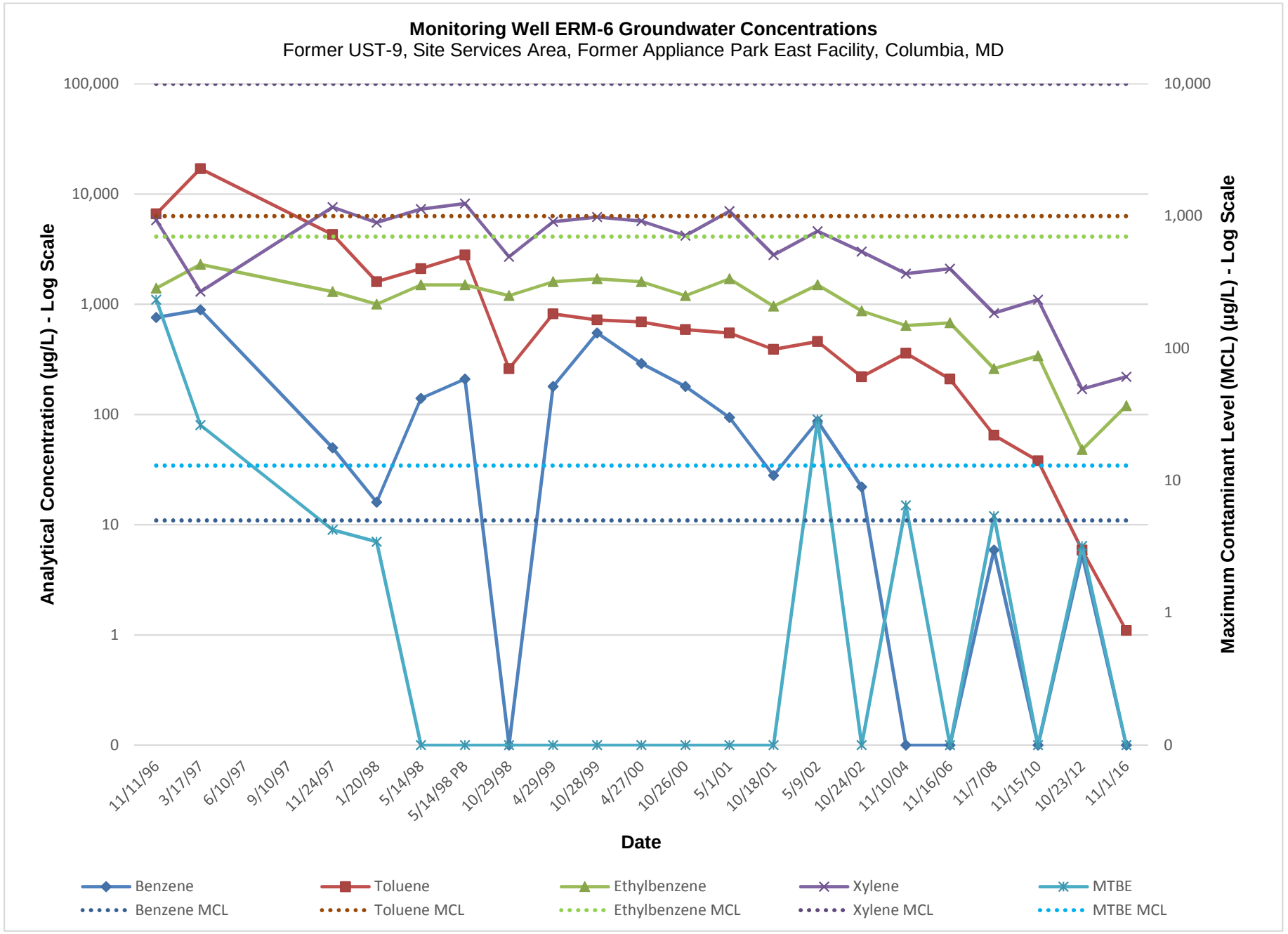
ATTACHMENT A

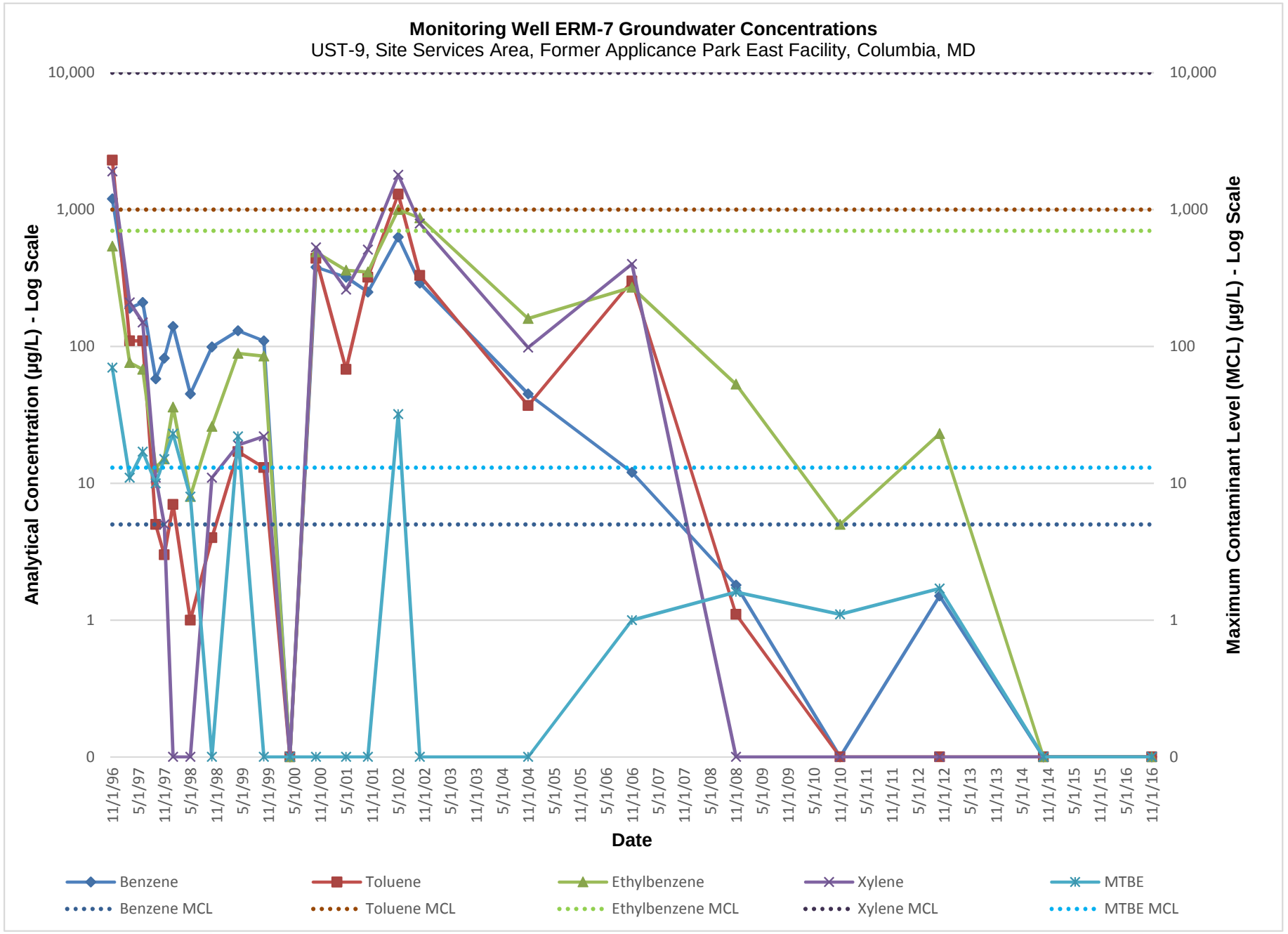
Time-Series Plots

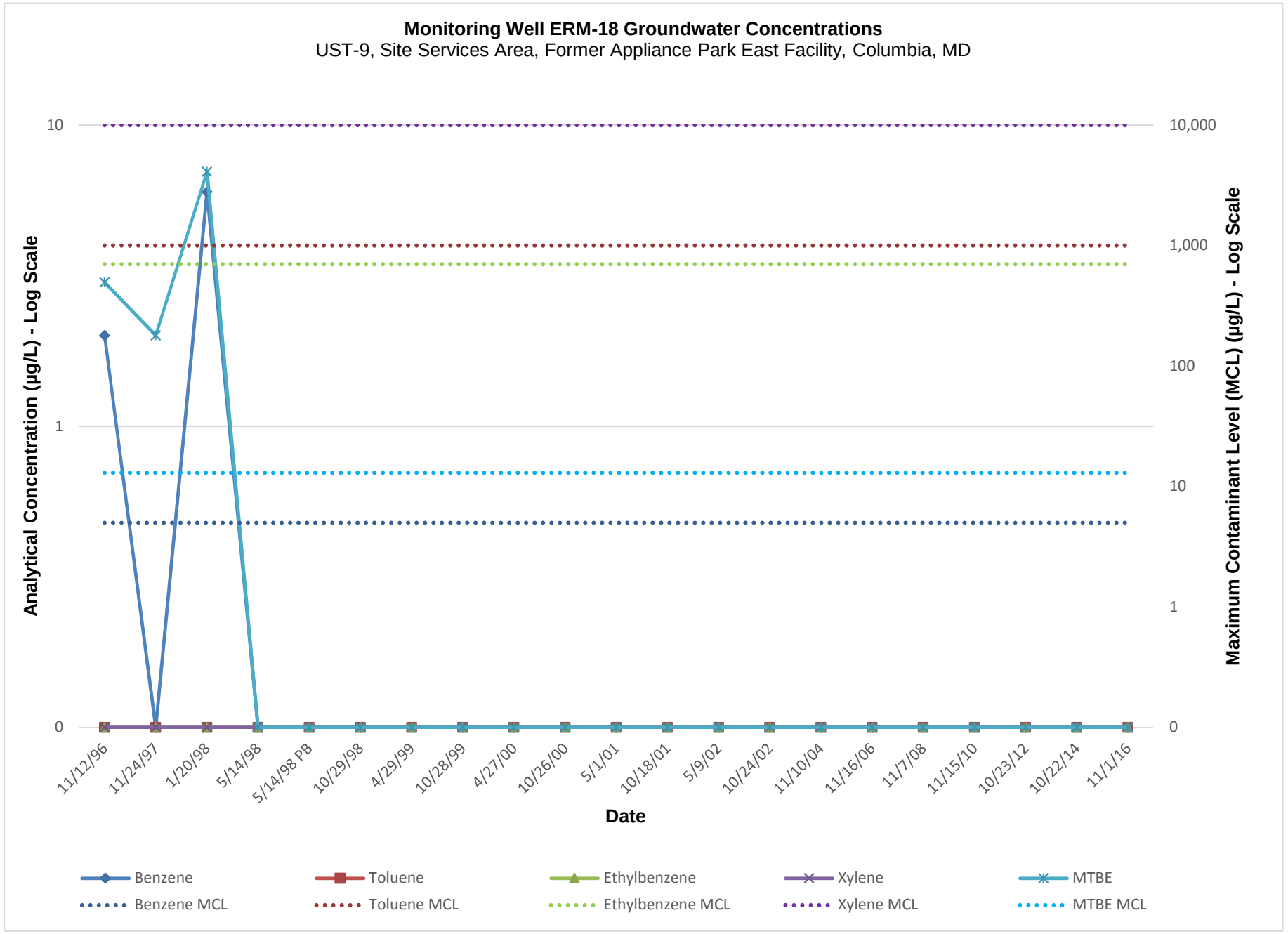
(10 pages)

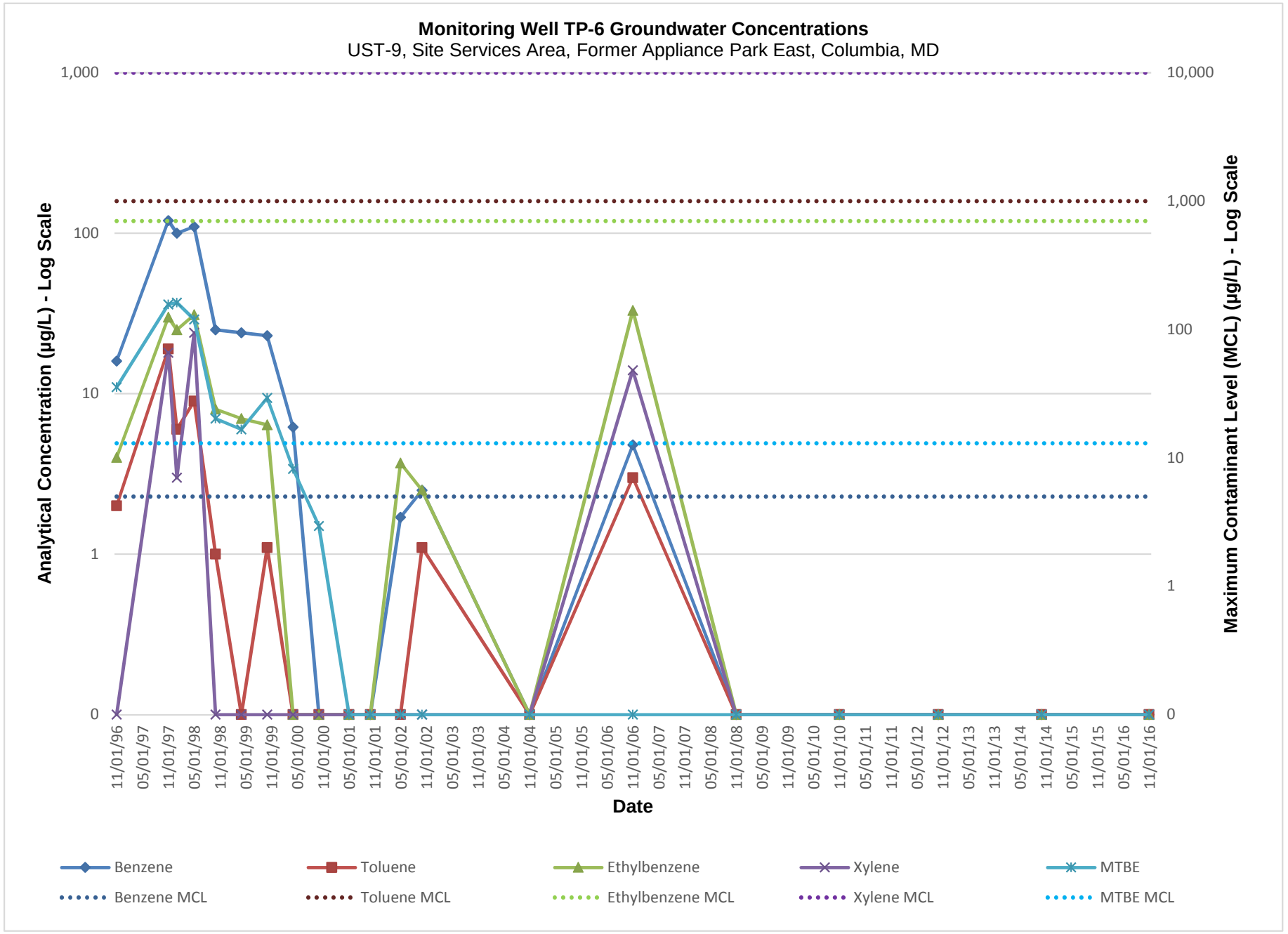
Monitoring Well ERM-4 Groundwater Concentrations
Former UST-9, Site Services Area, Former Appliance Park East Facility, Columbia, MD

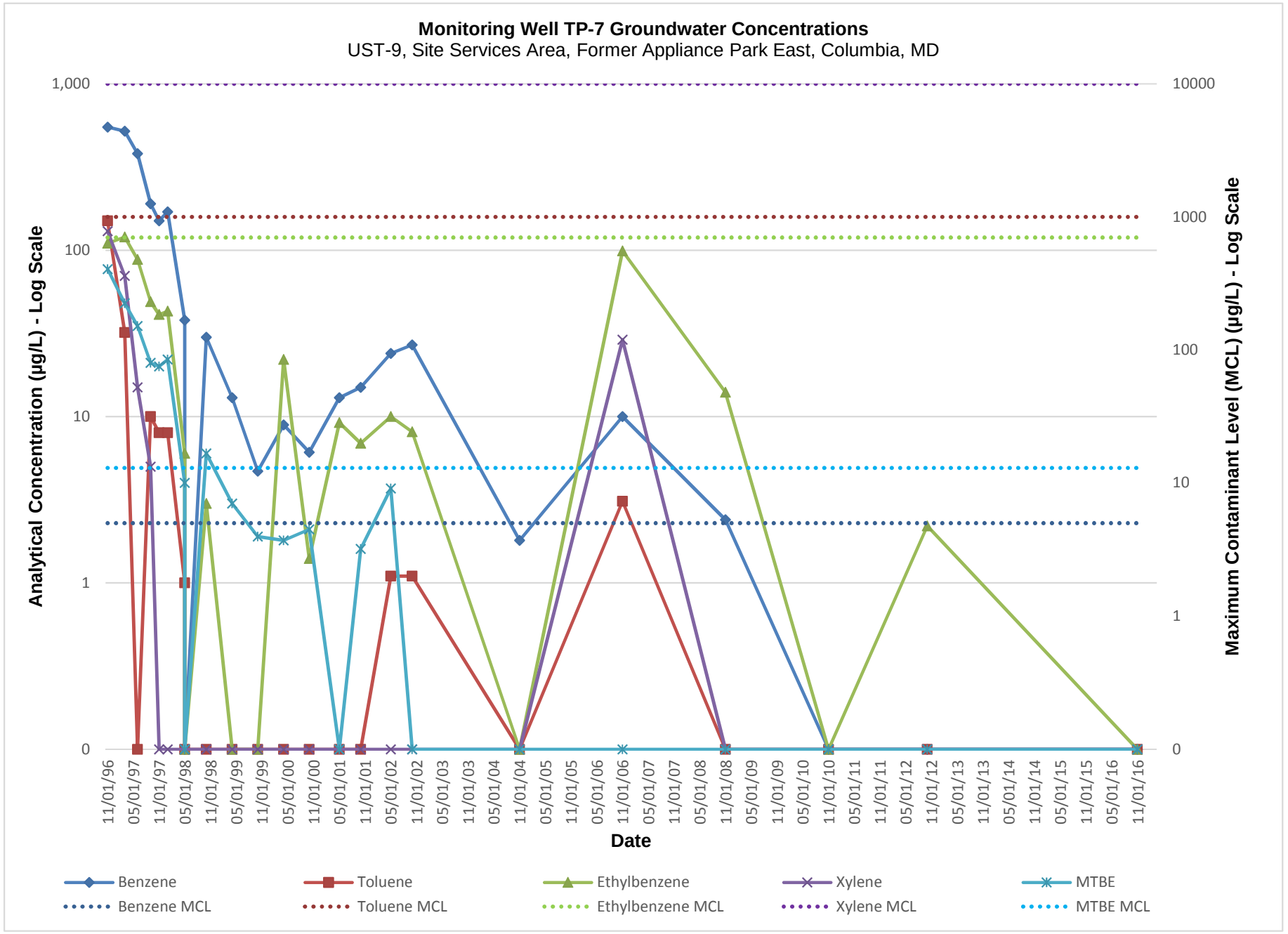


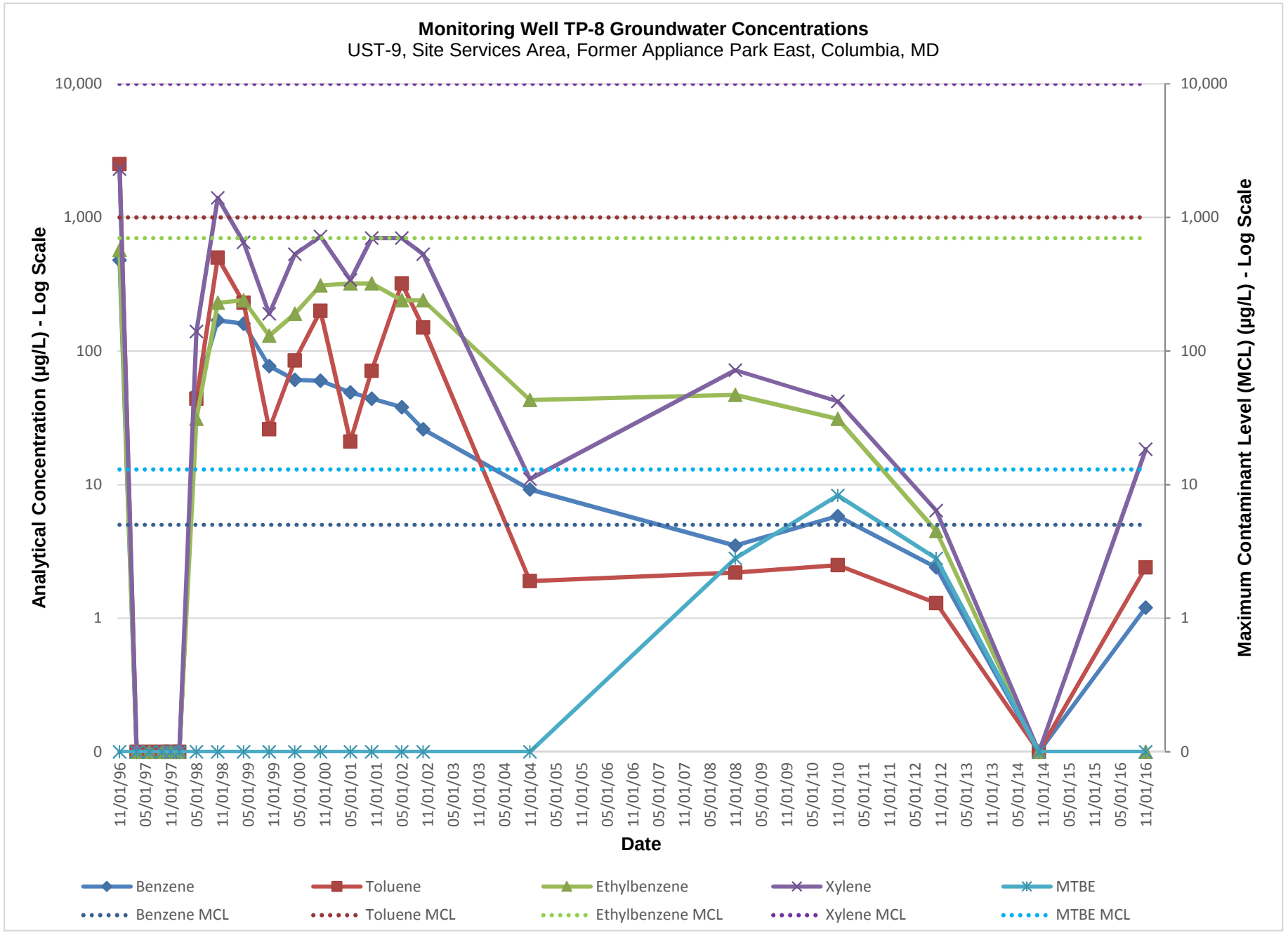

Monitoring Well ERM-6 Groundwater Concentrations
Former UST-9, Site Services Area, Former Appliance Park East Facility, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
100,000
10,000
1,000
100
10
1
0
10,000
1,000
100
10
1
0
11/11/96
3/17/97
6/10/97
9/10/97
11/24/97
1/20/98
5/14/98
5/14/98 PB
10/29/98
4/29/99
10/28/99
4/27/00
10/26/00
5/1/01
10/18/01
5/9/02
10/24/02
11/10/04
11/16/06
11/7/08
11/15/10
10/23/12
11/1/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL

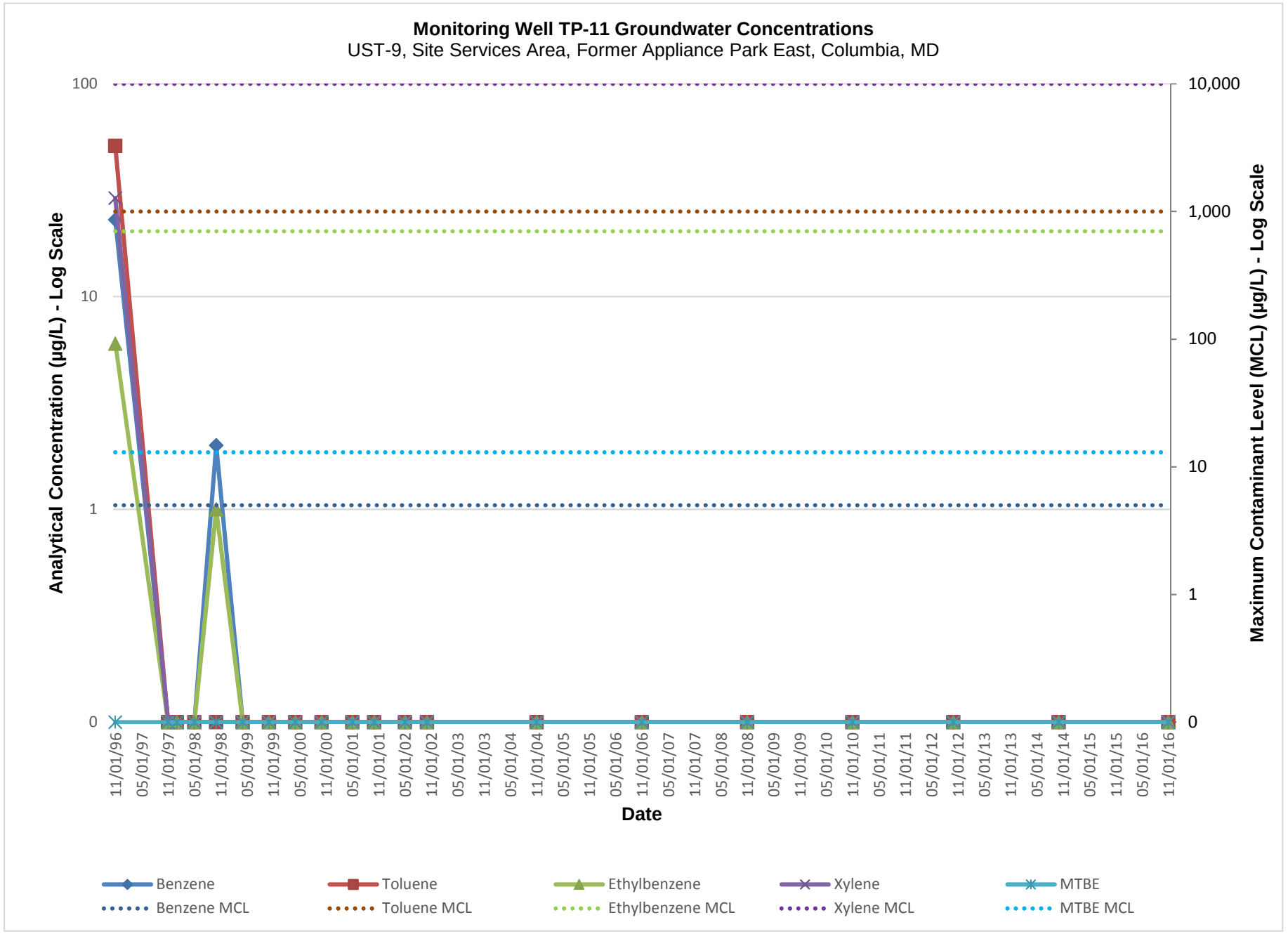

Monitoring Well ERM-7 Groundwater Concentrations
UST-9, Site Services Area, Former Applicance Park East Facility, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
10,000
1,000
100
10
1
0
11/1/96
5/1/97
11/1/97
5/1/98
11/1/98
5/1/99
11/1/99
5/1/00
11/1/00
5/1/01
11/1/01
5/1/02
11/1/02
5/1/03
11/1/03
5/1/04
11/1/04
5/1/05
11/1/05
5/1/06
11/1/06
5/1/07
11/1/07
5/1/08
11/1/08
5/1/09
11/1/09
5/1/10
11/1/10
5/1/11
11/1/11
5/1/12
11/1/12
5/1/13
11/1/13
5/1/14
11/1/14
5/1/15
11/1/15
5/1/16
11/1/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL

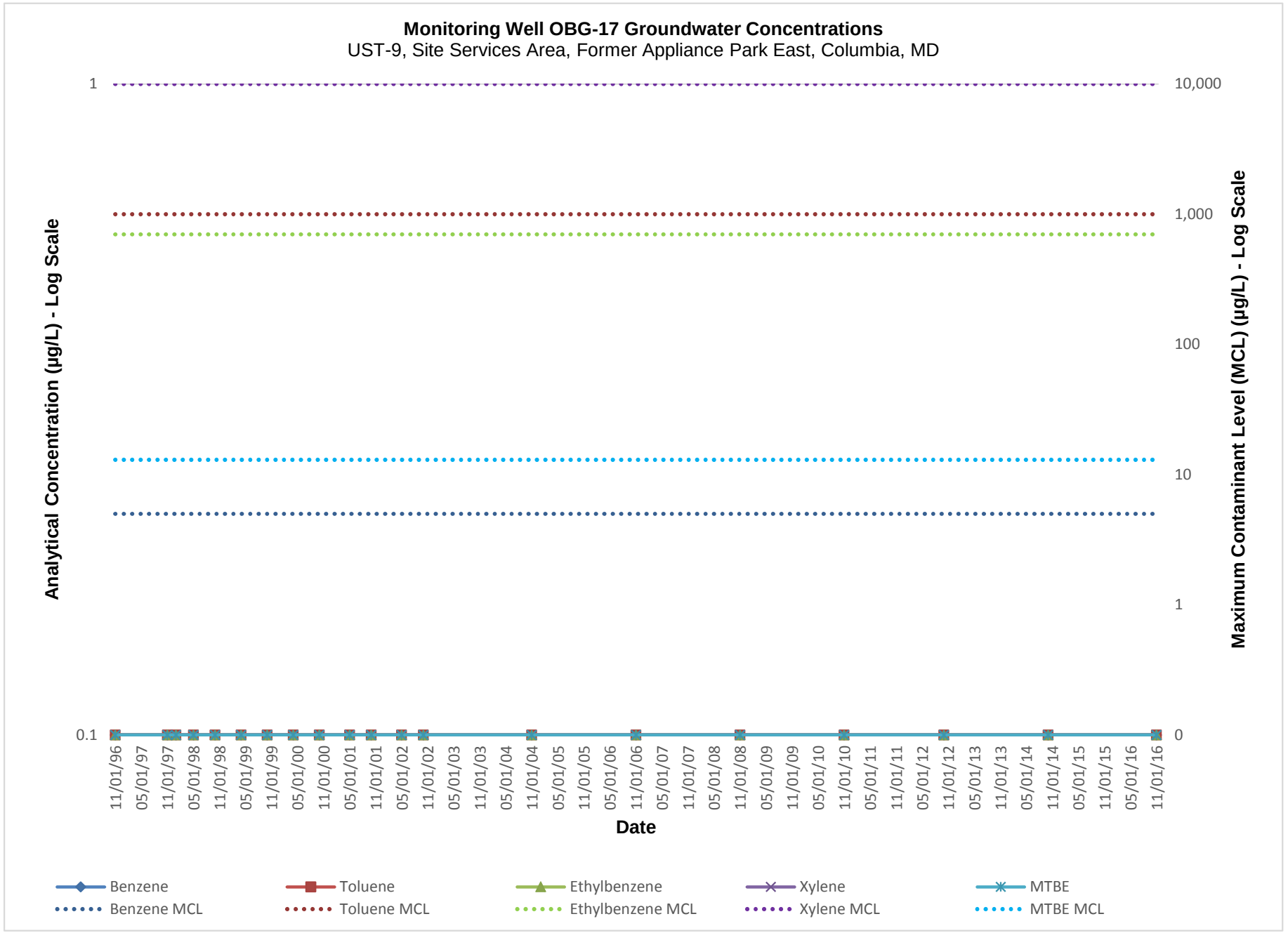

Monitoring Well ERM-18 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East Facility, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
10
1
0
10,000
1,000
100
10
1
0
11/12/96
11/24/97
1/20/98
5/14/98
5/14/98 PB
10/29/98
4/29/99
10/28/99
4/27/00
10/26/00
5/1/01
10/18/01
5/9/02
10/24/02
11/10/04
11/16/06
11/7/08
11/15/10
10/23/12
10/22/14
11/1/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL

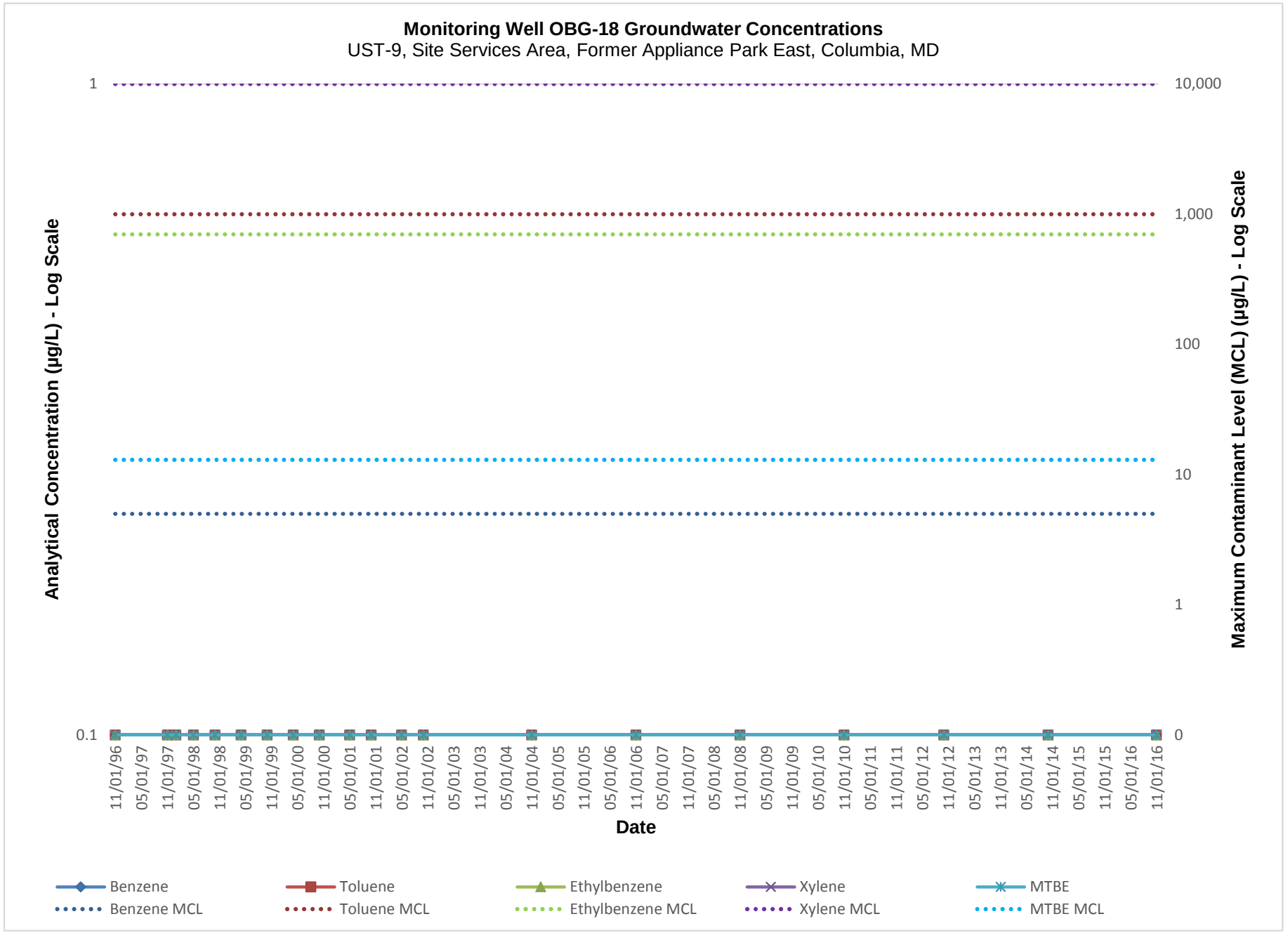

Monitoring Well TP-6 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
1,000
100
10
1
0
10,000
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL


Monitoring Well TP-7 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
1,000
100
10
1
0
10000
1000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL


Monitoring Well TP-8 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
10,000
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL


Monitoring Well TP-11 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
100
10
1
0
10,000
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL


Monitoring Well OBG-17 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
1
0.1
10,000
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL

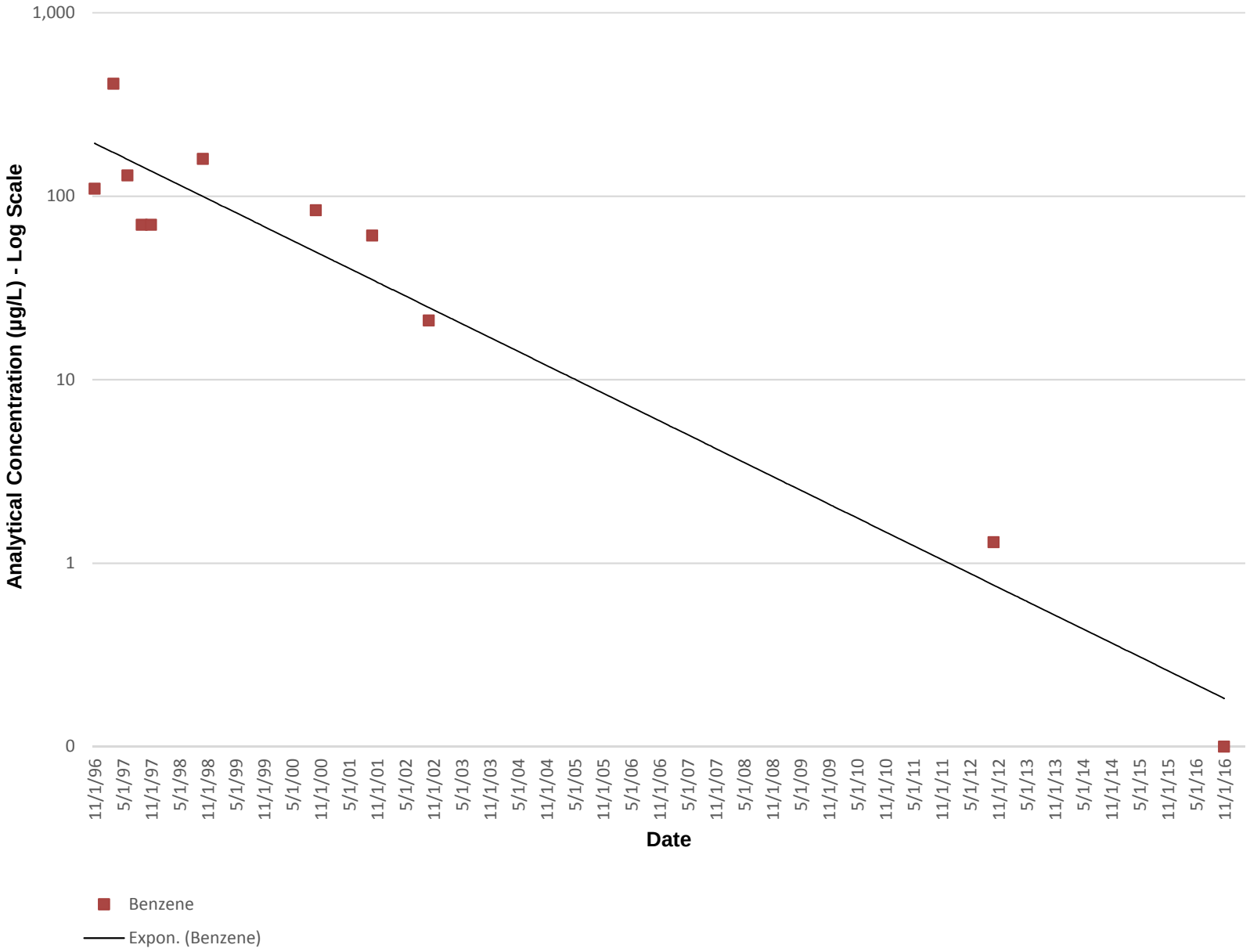

Monitoring Well OBG-18 Groundwater Concentrations
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
Maximum Contaminant Level (MCL) (µg/L) - Log Scale
1
0.1
10,000
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Toluene
Ethylbenzene
Xylene
MTBE
Benzene MCL
Toluene MCL
Ethylbenzene MCL
Xylene MCL
MTBE MCL

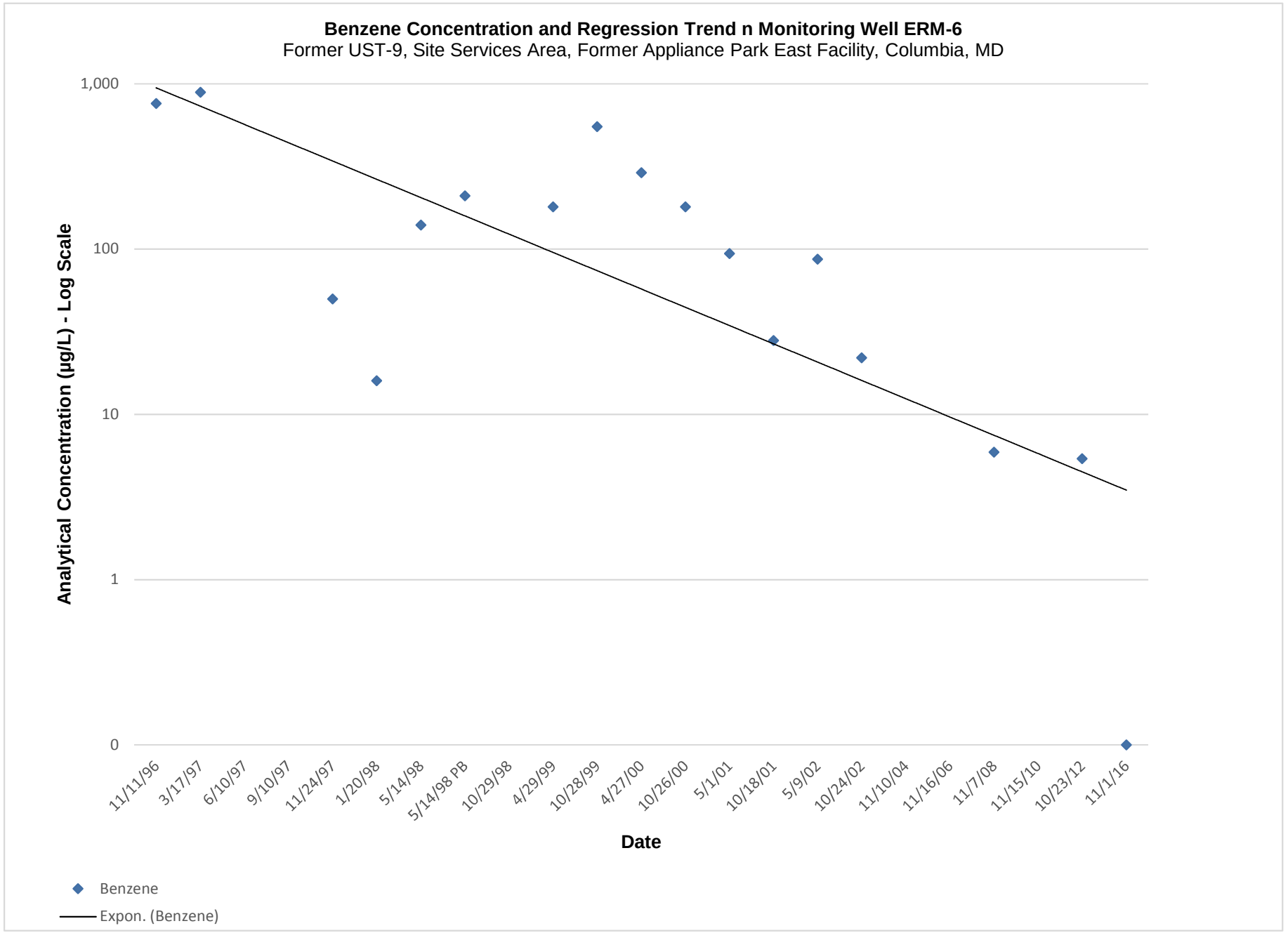
ATTACHMENT B

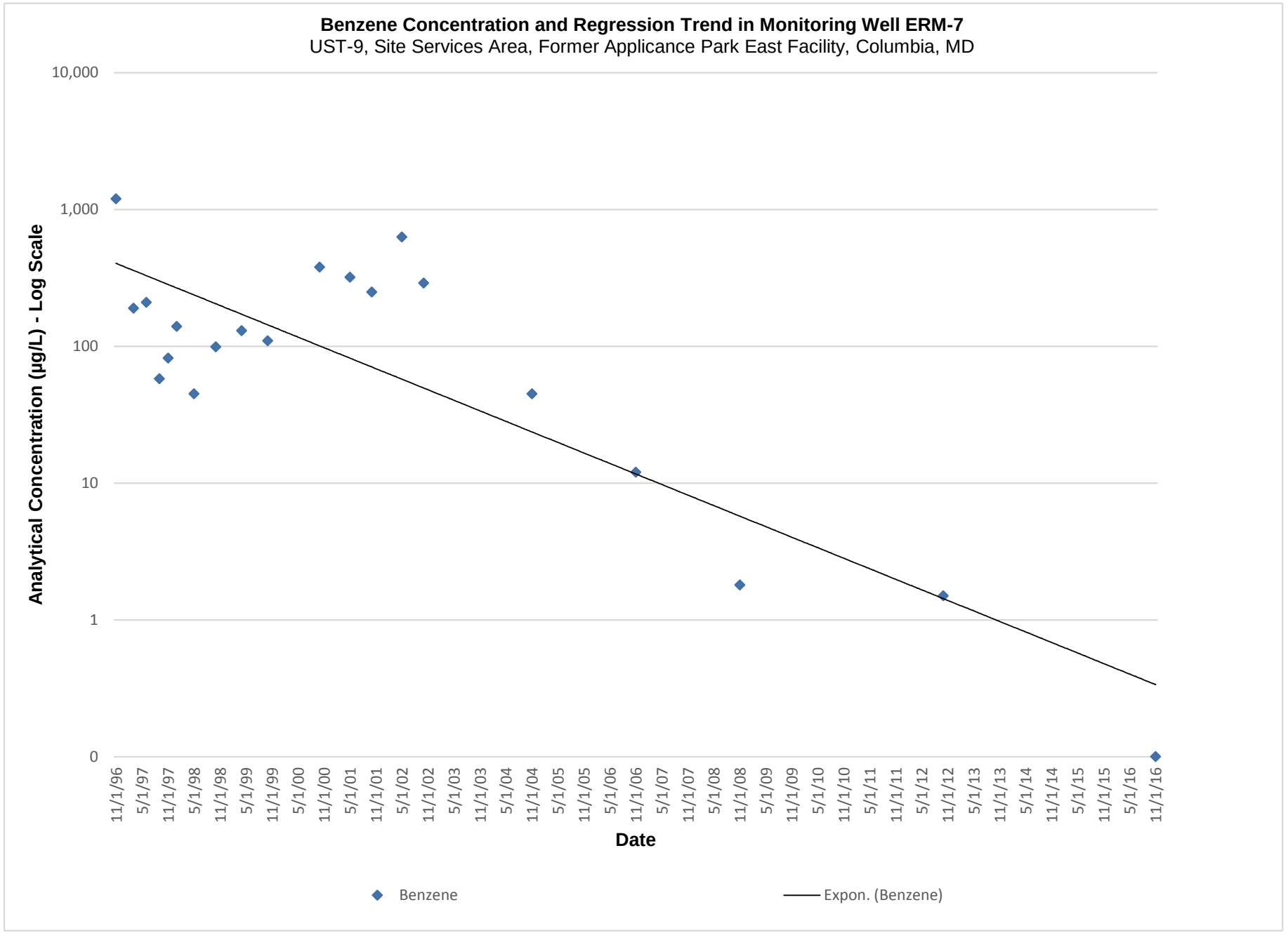
Benzene Regression Analysis Plots

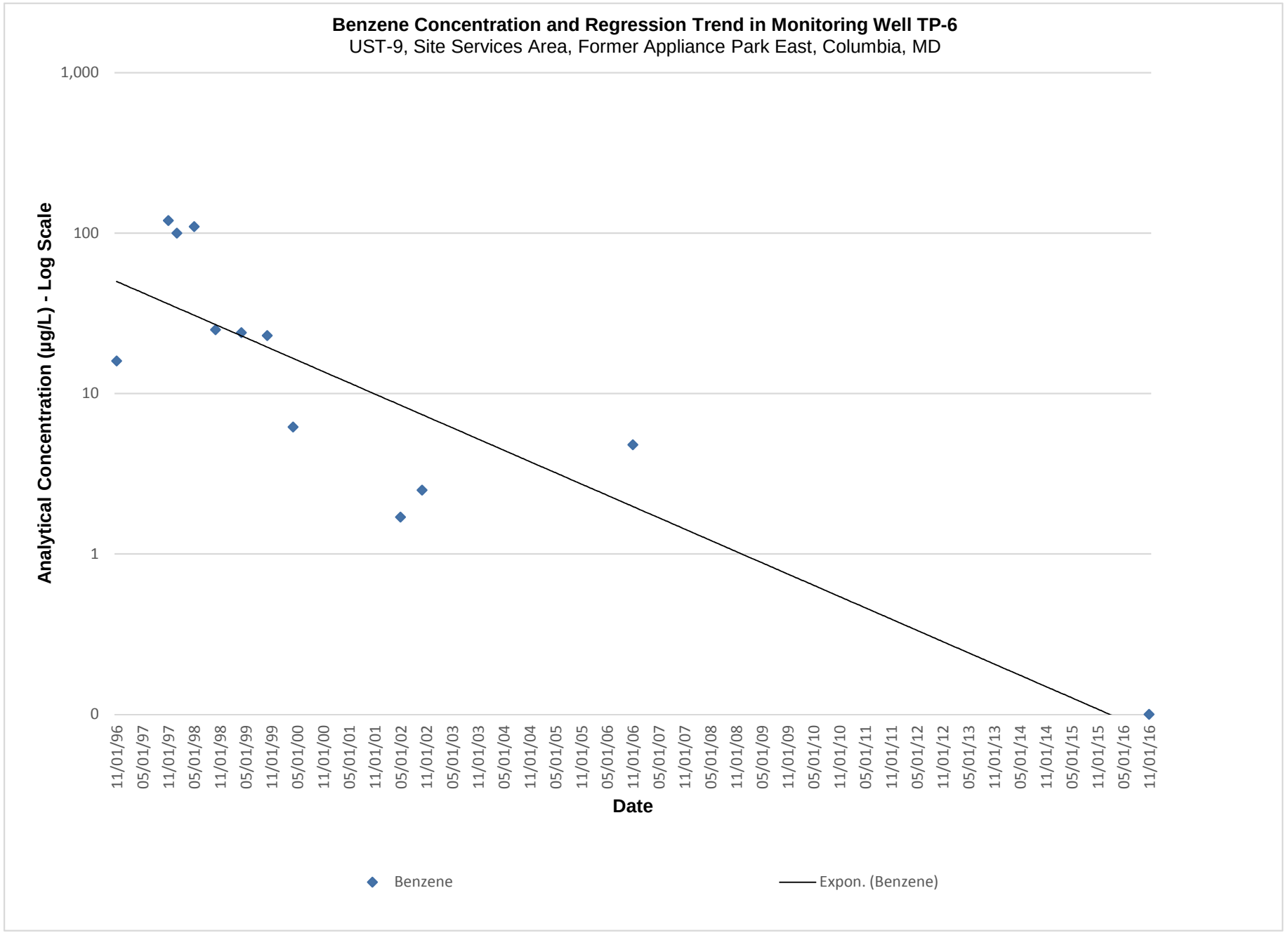
(7 pages)

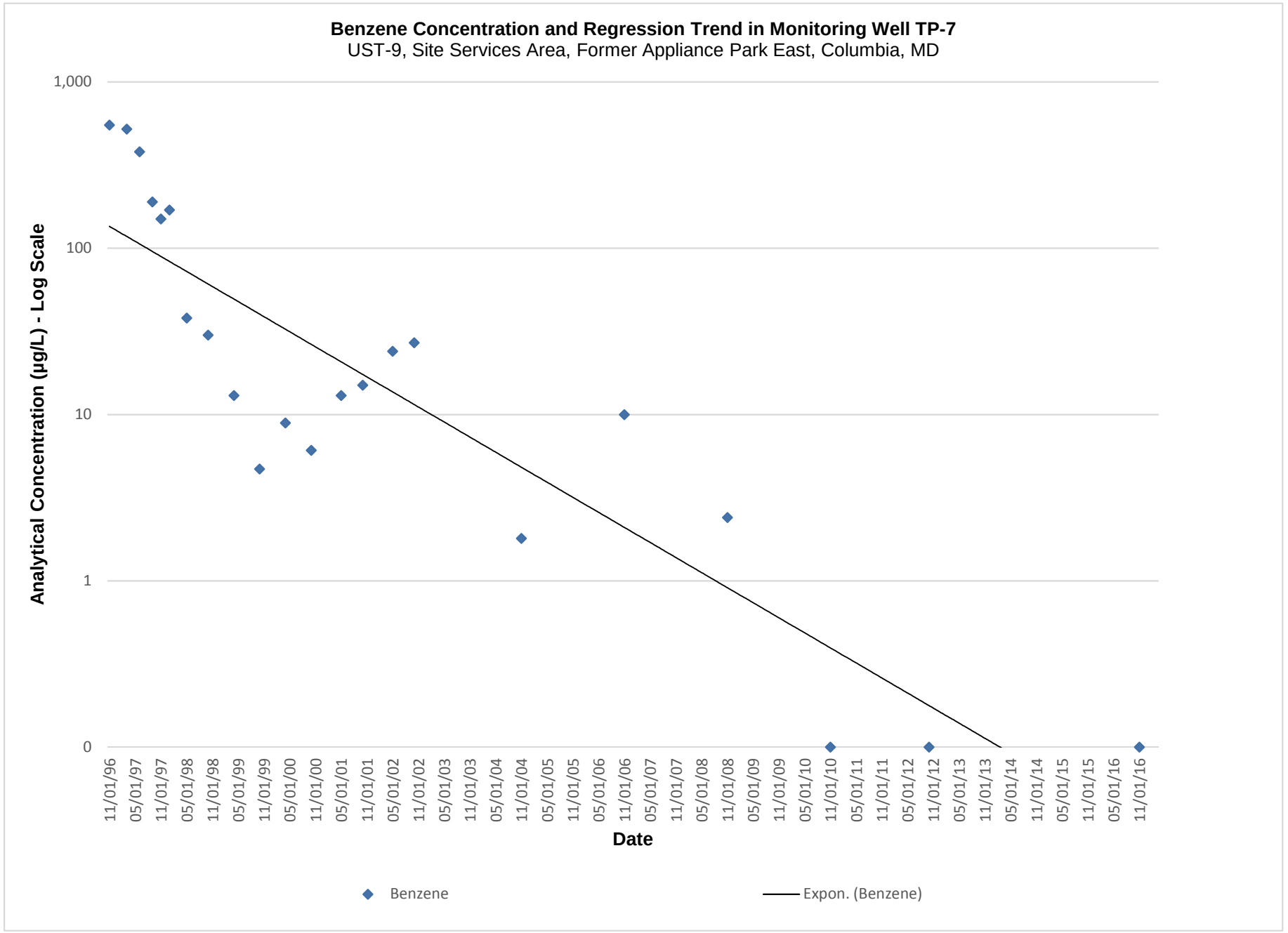
Benzene Concentration and Regression Trend in Monitoring Well ERM-4
Former UST-9, Site Services Area, Former Appliance Park East Facility, Columbia, MD



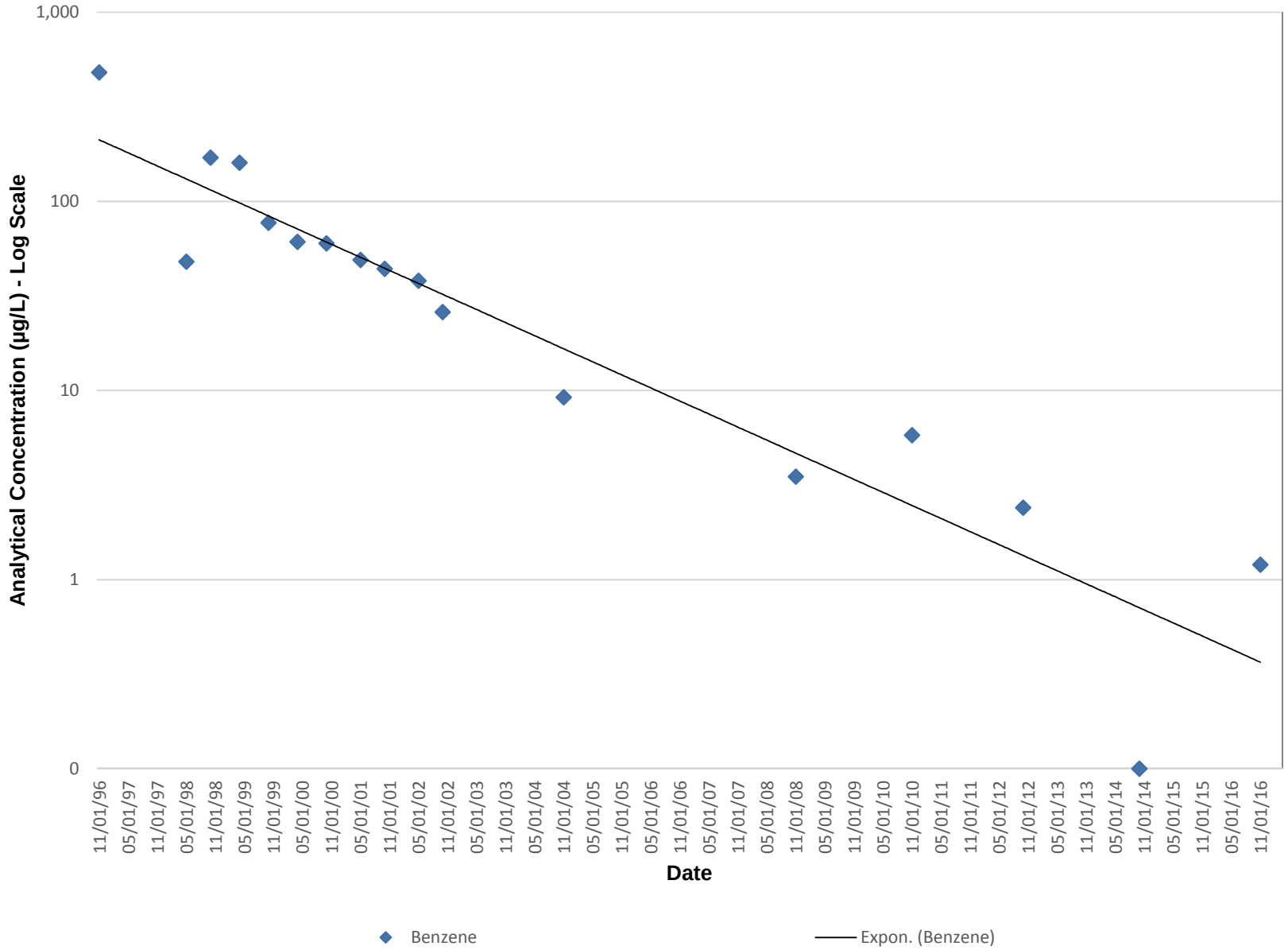

Benzene Concentration and Regression Trend n Monitoring Well ERM-6
Former UST-9, Site Services Area, Former Appliance Park East Facility, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
1,000
100
10
1
0
11/11/96
3/17/97
6/10/97
9/10/97
11/24/97
1/20/98
5/14/98
5/14/98 PB
10/29/98
4/29/99
10/28/99
4/27/00
10/26/00
5/1/01
10/18/01
5/9/02
10/24/02
11/10/04
11/16/06
11/7/08
11/15/10
10/23/12
11/1/16
Date
Benzene
Expon. (Benzene)

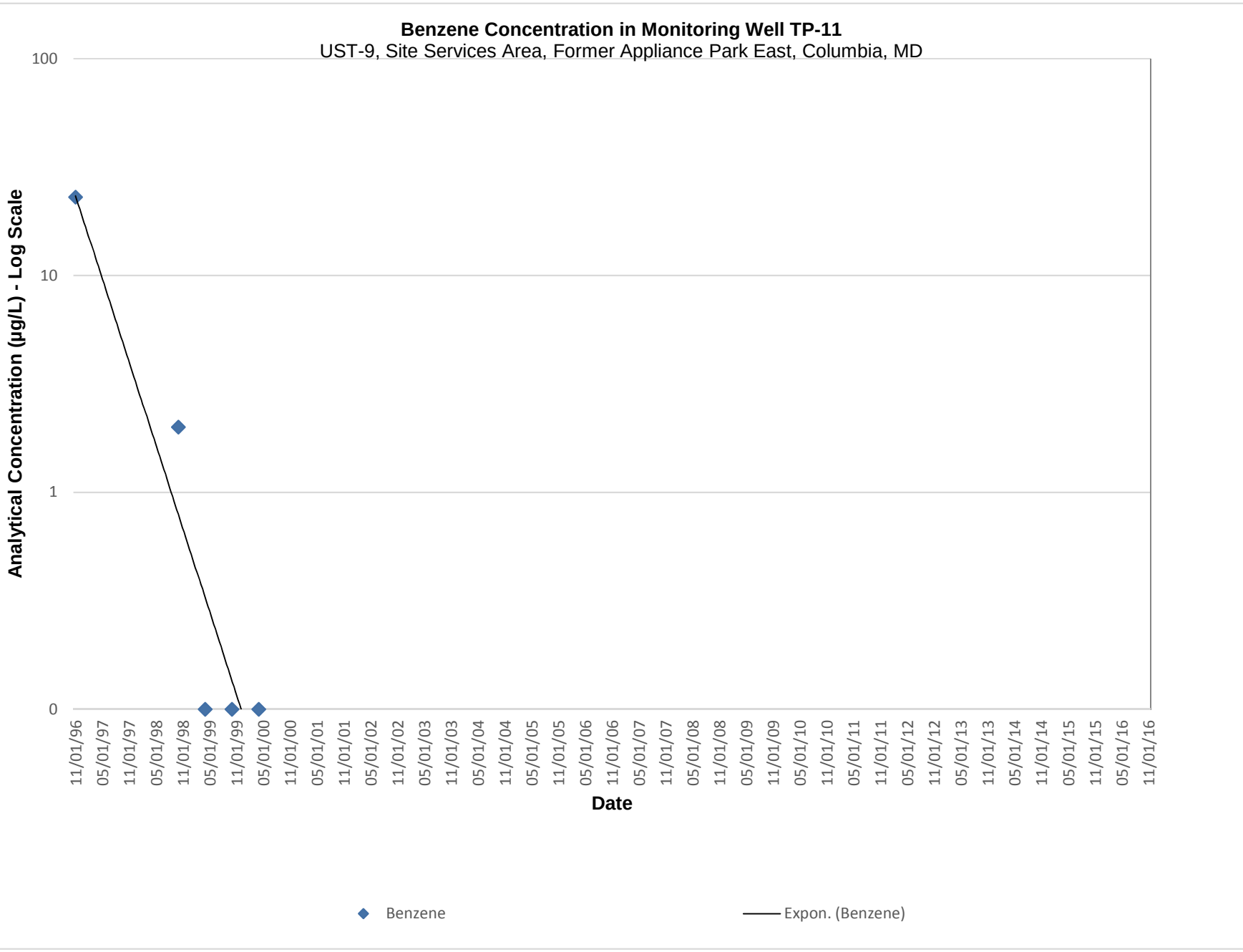

Benzene Concentration and Regression Trend in Monitoring Well ERM-7
UST-9, Site Services Area, Former Applicance Park East Facility, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
10,000
1,000
100
10
1
0
11/1/96
5/1/97
11/1/97
5/1/98
11/1/98
5/1/99
11/1/99
5/1/00
11/1/00
5/1/01
11/1/01
5/1/02
11/1/02
5/1/03
11/1/03
5/1/04
11/1/04
5/1/05
11/1/05
5/1/06
11/1/06
5/1/07
11/1/07
5/1/08
11/1/08
5/1/09
11/1/09
5/1/10
11/1/10
5/1/11
11/1/11
5/1/12
11/1/12
5/1/13
11/1/13
5/1/14
11/1/14
5/1/15
11/1/15
5/1/16
11/1/16
Date
Benzene
Expon. (Benzene)


Benzene Concentration and Regression Trend in Monitoring Well TP-6
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Expon. (Benzene)


Benzene Concentration and Regression Trend in Monitoring Well TP-7
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
1,000
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Expon. (Benzene)

Benzene Concentration and Regression Trend in Monitoring Well TP-8
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD




Benzene Concentration in Monitoring Well TP-11
UST-9, Site Services Area, Former Appliance Park East, Columbia, MD
Analytical Concentration (µg/L) - Log Scale
100
10
1
0
11/01/96
05/01/97
11/01/97
05/01/98
11/01/98
05/01/99
11/01/99
05/01/00
11/01/00
05/01/01
11/01/01
05/01/02
11/01/02
05/01/03
11/01/03
05/01/04
11/01/04
05/01/05
11/01/05
05/01/06
11/01/06
05/01/07
11/01/07
05/01/08
11/01/08
05/01/09
11/01/09
05/01/10
11/01/10
05/01/11
11/01/11
05/01/12
11/01/12
05/01/13
11/01/13
05/01/14
11/01/14
05/01/15
11/01/15
05/01/16
11/01/16
Date
Benzene
Expon. (Benzene)